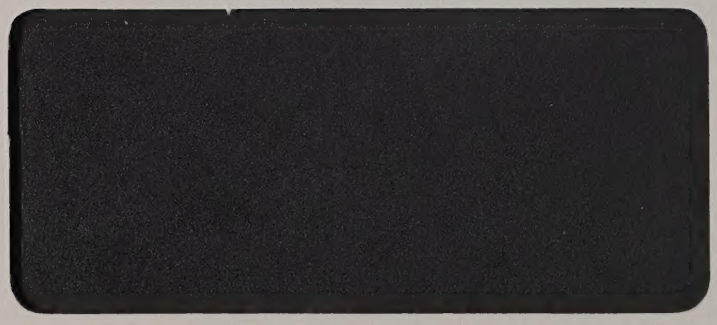
ME-3184

narda *Microline*®

# INSTRUCTION MANUAL

**PRECISION MICROWAVE AND RF TEST EQUIPMENT**

THE NARDA MICROWAVE CORPORATION, PLAINVIEW, L. I., N. Y. 11803 • 516 GE 3-9000



# THE NARDA MICROWAVE CORPORATION

# TECHNICAL MANUAL
# OPERATING AND MAINTENANCE INSTRUCTIONS

## FOR

## MODEL B86B3
## ELECTROMAGNETIC RADIATION MONITOR

Equipment Serial No. 08005

982100092

June 1971

# WARRANTY

THE NARDA MICROWAVE CORPORATION

Warrants each instrument of its manufacture to be free from defect in material and workmanship. The limit of liability under this warranty is to repair and replace any instrument or part thereof which shall, within one year after delivery to the original purchaser, and returned by the orginating purchaser, prove to be defective after examination by us. However, this warranty specifically excludes tubes or transistors, fuses, IC's, diodes and batteries. Warranty returns must first be authorized by factory office or representative.

The NARDA Microwave Corporation also reserves the right to make changes in design on any of its products without incurring any obligation to make the same changes on units previously purchased.

This warranty is the extent of the obligations or liabilities assumed by The NARDA Microwave Corporation with respect to its instruments, and the NARDA Microwave Corporation neither makes nor authorizes any other person to make any other guaranty or warranty concerning these instruments.

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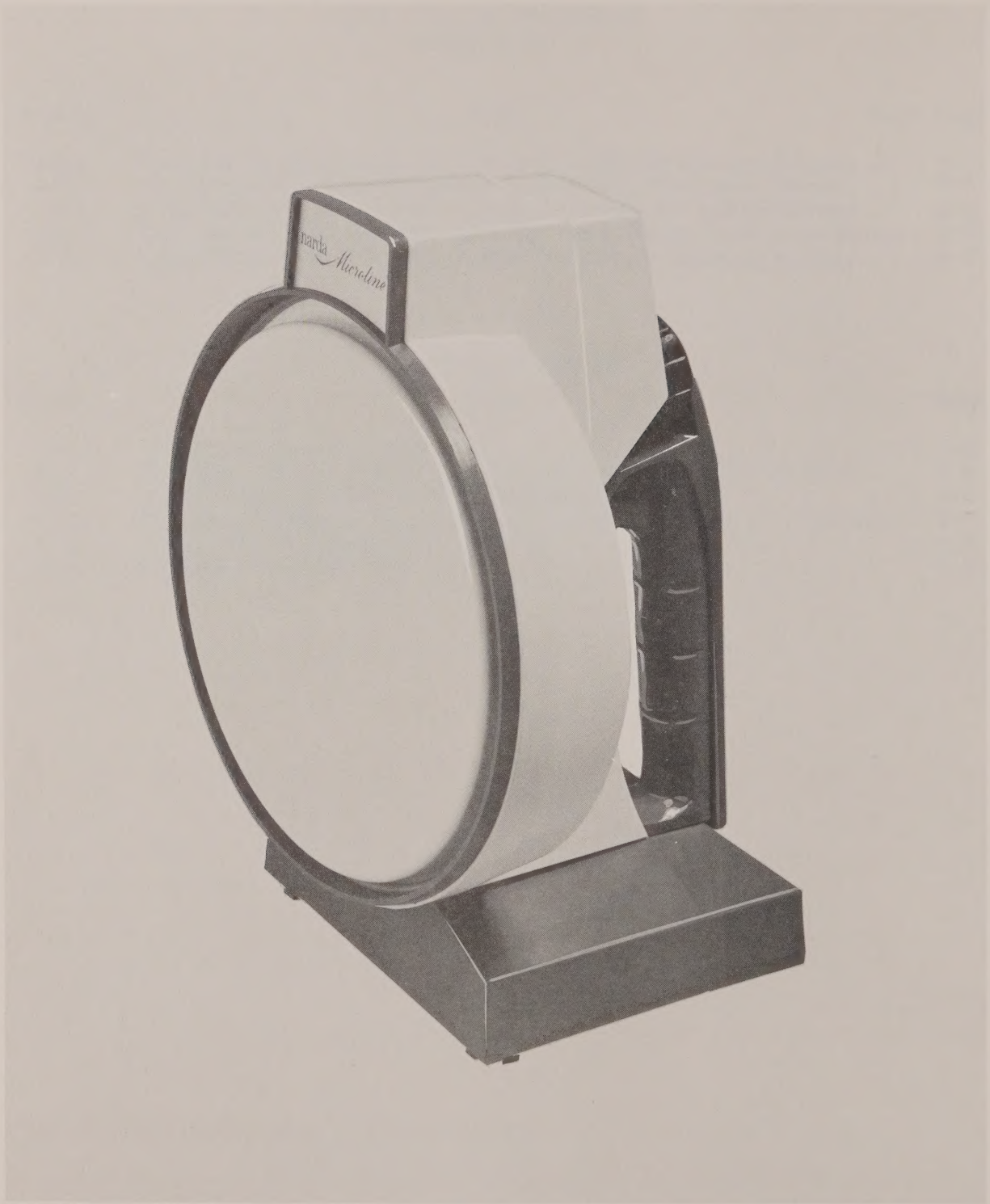


Figure 1-1. Narda Model B86B3 Electromagnetic Radiation Monitor

# SECTION I

# GENERAL DESCRIPTION

## 1-1. INTRODUCTION.

1-2. This manual provides instructions for the use and maintenance of the Narda Model B86B3 Electromagnetic Radiation Monitor, designed and manufactured by the Narda Microwave Corporation, Plainview, Long Island, New York. The manual includes a general description of the equipment, installation and operating instructions, theory of operation, maintenance data and a replaceable parts list.

## 1-3. PURPOSE AND USE OF EQUIPMENT.

1-4. The Narda Microline Model B86B3 Electromagnetic Radiation Monitor (figure 1-1), is a portable, battery-operated precision instrument designed for rapid, simple detection and indication of radiated fields emanating from high power microwave sources in radar and communications work. The Monitor, in detecting electromagnetic power density throughout the 0.45 to 12.4 GHz frequency band, ensures personnel safety in the proximity of these high power microwave sources.

1-5. The Monitor presents a 7-inch diameter antenna aperture to the radiation field, which responds to all planes of polarization; linear left- and right-hand circular, random, pulsed or continuous wave. All energy incident upon the antenna is integrated, and total field density is read directly on the output meter which is calibrated in $mw/cm^2$.

1-6. The instrument is housed in a high-impact plastic case with integral handle. A combined On-Off-Zero adjust knob is used to zero the meter before exposing the Monitor to an r-f field. A correction factor chart, calibrated at 13 discrete frequencies within the operating bandwidth for Model B86B3, is supplied with each instrument and facilitates interpolation of actual field density in $mw/cm^2$ as read on the output meter. A recorder output jack is also provided for remote readout of field density on an external meter or recording device. When remote readout is desired, the instrument meter is bypassed.

1-7. In addition to its use as safety equipment, the Monitor offers a rapid, accurate means for checking leakage at transmitter and antenna couplings, and for fast measurement of transmitted power at specified distances from an antenna. Since the unit is battery-powered and easily operated with one hand, it can be readily used in difficult access locations such as antenna towers and shipboard antenna installations.

## 1-8. EQUIPMENT SPECIFICATIONS.

1-9. Table 1-1 provides a listing of pertinent electrical and mechanical specifications for the Monitor.

## 1-10. EQUIPMENT SUPPLIED

1-11. The Monitor is supplied with an integral 3-foot line cord used for battery charging; the line cord is stored in the base of the instrument. Optional equipment includes an instrument carrying case.

## 1-12. PRINCIPLES OF OPERATION.

1-13. To effectively monitor radiated energy over a broad bandwidth, several antennas would be required, since each antenna usually covers less than one octave in frequency. Consequently, it becomes necessary to make a series of radiation measurements employing each antenna, in turn, in order to determine total energy in a given frequency range. In addition, conventional monitors are usually sensitive to linear polarization of only one orientation. As a result, it becomes necessary to rotate the antenna axially in order to align the plane of polarization of the antenna with that of the received energy. If circularly polarized radiation is encountered with such devices, the measurement can be in error by 3 db.

1-14. The Narda Monitor overcomes the difficulties encountered with previous power density measuring devices through its unique antenna sensing circuit. The antenna element incorporates four thermistors, two for high frequencies and two for low frequencies, arranged in a bridge configuration. These are positioned on the antenna element so that the total of r-f power absorbed is essentially equal to the total of power in all modes of polarization. Bridge output voltage is measured by a 1.0 ma, 50-millivolt full-scale meter calibrated in milliwatts/centimeter$^2$.

1-15. In use, the bridge is first balanced by adjusting the Zero control to inject dc current into the bridge, establishing the thermistor resistance at 390 ohms. When the unit is placed in an r-f field, the energy absorbed by the thermistors causes the bridge to be unbalanced, resulting in a meter deflection corresponding to the amount of unbalance. Quantitative measurements of cw or pulsed power density are obtained by multiplying the meter reading by a correction factor provided on the calibration chart. For remote readouts, a remote 50-millivolt full-scale meter movement should be used and its movement should first be calibrated against the monitor meter scale to provide readout in mw/cm$^2$.

Table 1-1. Equipment Specifications

| | |
|---|---|
| Safe Power Indication | 10 mw/cm$^2$ |
| Power Range | 0.5 to 20 mw/cm$^2$ |
| Power Accuracy | 1.0 db from 1.0 to 12.4 $GH_Z$, 2.0 db from 0.45 to 1.0 $GH_Z$ (with calibration chart) |
| Frequency Range | 0.45 to 12.4 $GH_Z$ |
| Frequency Sensitivity | 10 db |
| Battery Data | 15-volt nickel-cadmium rechargeable battery |
| *Recharging Voltage | 110 volts, 50 to 60 $H_Z$ |

*The instrument battery may be recharged from a 220-volt, 50 to 60 $H_Z$ source with slight modification to the charge circuit.

Table 1-1. Equipment Specifications (Continued)

| | |
|---|---|
| Operating Temperature Range . . . . . | Ambient temperature range of -4° F to +120° F. Accurate readings may be taken at ambient temperatures as low as -40° F, provided the instrument is first zeroed at normal operating temperatures and then re-zeroed at the lower ambient. |
| Weight . . . . . | 3. 0 pounds (approx) |
| Dimensions . . . . . | 6-1/2" D x 10-11/32" H x 7-17/32" W |

1-16. SEMICONDUCTOR COMPLEMENT.

1-17. The only semiconductors contained in the Monitor are four type 1N645 diodes, CR1 through CR4, which form the battery-charging bridge rectifier circuit.

# SECTION II

# INSTALLATION AND OPERATION

## 2-1. GENERAL

2-2. The Monitor is shipped complete and ready to operate; no special installation procedures are required unless a fixed station or system type of installation is contemplated. The instrument should be carefully unpacked and inspected upon receipt; observe the usual precautions necessary when unpacking an electronic instrument.

## 2-3. INSTALLATION

2-4. The following paragraphs describe procedures required to unpack, inspect and set up the instrument prior to operation. An outline dimensional drawing of the Monitor is presented in figure 2-1.

2-5. UNPACKING AND INSPECTION. Upon receipt of the Monitor, perform a preliminary visual inspection of the container for evidence of damage during transportation. Any evidence of serious damage should be reported to the carrier prior to unpacking the equipment. If there is no evidence of damage, unpack the instrument following conventional unpacking procedures and using care.

NOTE

Keep container and packing materials should reshipment become necessary.

2-6. The Monitor was tested, calibrated and inspected at the factory prior to shipment. Immediately after unpacking the instrument, visually inspect it for damage incurred in transit, such as broken knob, jack, and meter, scratches on case, etc. Following visual inspection, check the Monitor electrically in accordance with the performance test procedure in Section IV of this manual. If there is any evidence of damage, immediately file a claim for damage in transit with the carrier. Packing instructions for reshipment are outlined in paragraphs 2-17 and 2-18.

2-7. PREOPERATIONAL PROCEDURES. The following paragraphs discuss procedures for setting up the Monitor for operation, and for making a minimum performance check.

2-8. Setup for Normal Operation. For normal operation of Model B86B3 no special setup requirements are necessary. Usually the instrument is hand-held in the path of the r-f field after proper meter-zeroing has been accomplished.

2-9. Performance Test. A comprehensive test to assure that the instrument is functioning properly can be made by executing the performance test procedure in Section IV of this manual.

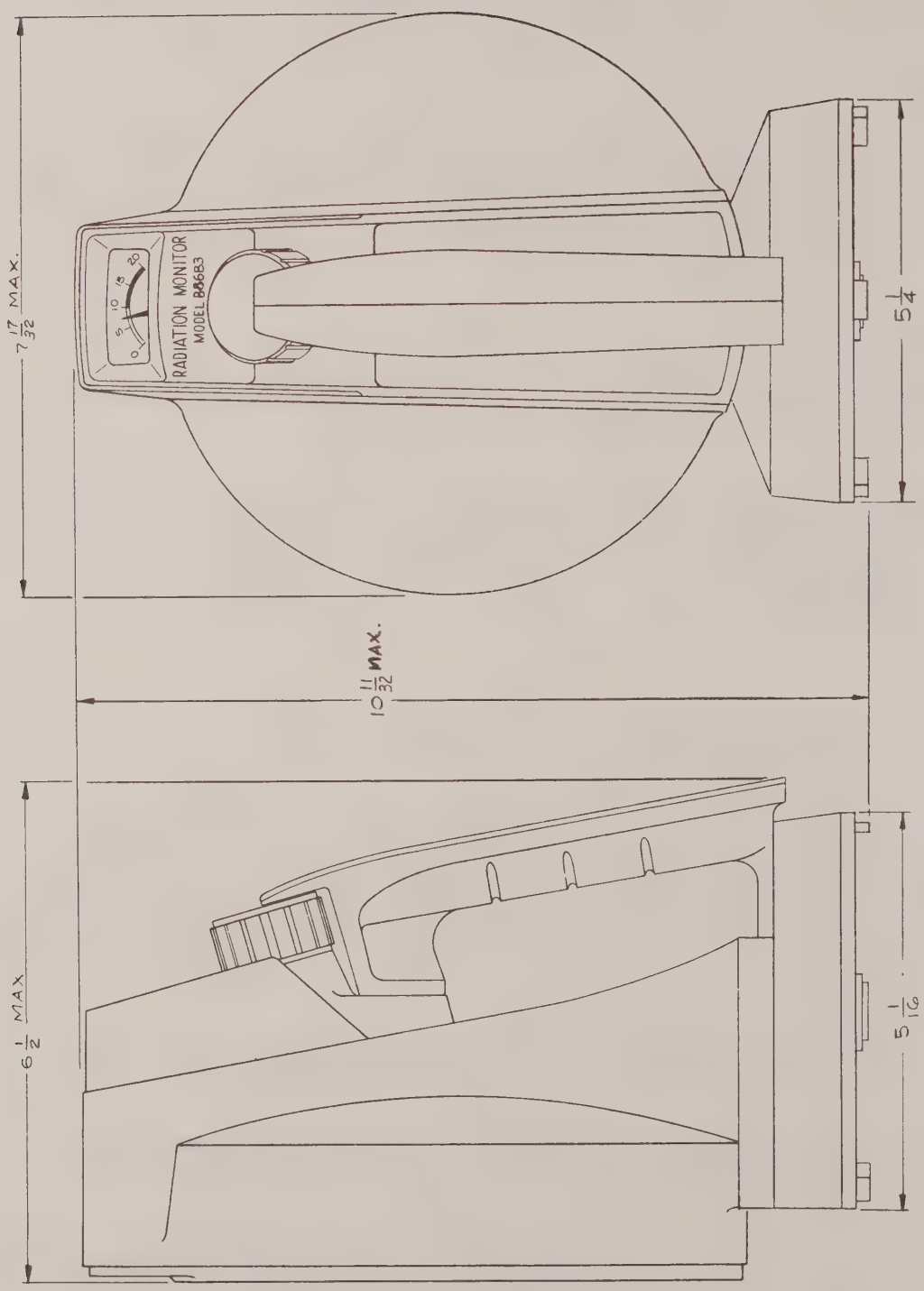


Figure 2-1. Radiation Monitor, Outline Dimensional Drawing

2-10. OPERATION.

2-11. The following paragraphs describe typical operating procedures for the Monitor, including battery use and charging information.

2-12. FUNCTIONS OF OPERATING CONTROLS, INDICATORS AND CONNECTORS. (See figure 2-2.) Operating controls, indicators and connectors for the Model B86B3 are illustrated in figure 2-2 and their functions are described in table 2-1.

2-13. NORMAL OPERATION. For normal operation of the Monitor, proceed as follows:

CAUTION

When measuring field density at specified distance from radiating source, particularly a high power source, mark off desired distance from source. After zeroing meter at a considerable distance past desired spot, slowly walk toward marked area while noting indication. If indication approaches danger level (10 mw/$cm^2$) before area is reached, a remote measurement must be made. (Refer to paragraph 2-14.)

a. Point instrument away from r-f energy source and rotate integral On-Off-Zero control knob clockwise.

NOTE

If meter will not zero, or exhibits excessive drift about zero point, recharge or replace battery.

b. Slowly rotate On-Off-Zero control knob clockwise until meter pointer moves; vary control to obtain zero reading.

c. Scan instrument about horizontal and vertical axis until maximum meter reading is obtained. Field density level as indicated on meter is integrated reading of all r-f energy incident upon antenna from that particular direction.

d. Multiply meter reading by FIELD DENSITY correction factor for r-f source operating frequency to obtain accurate field density level.

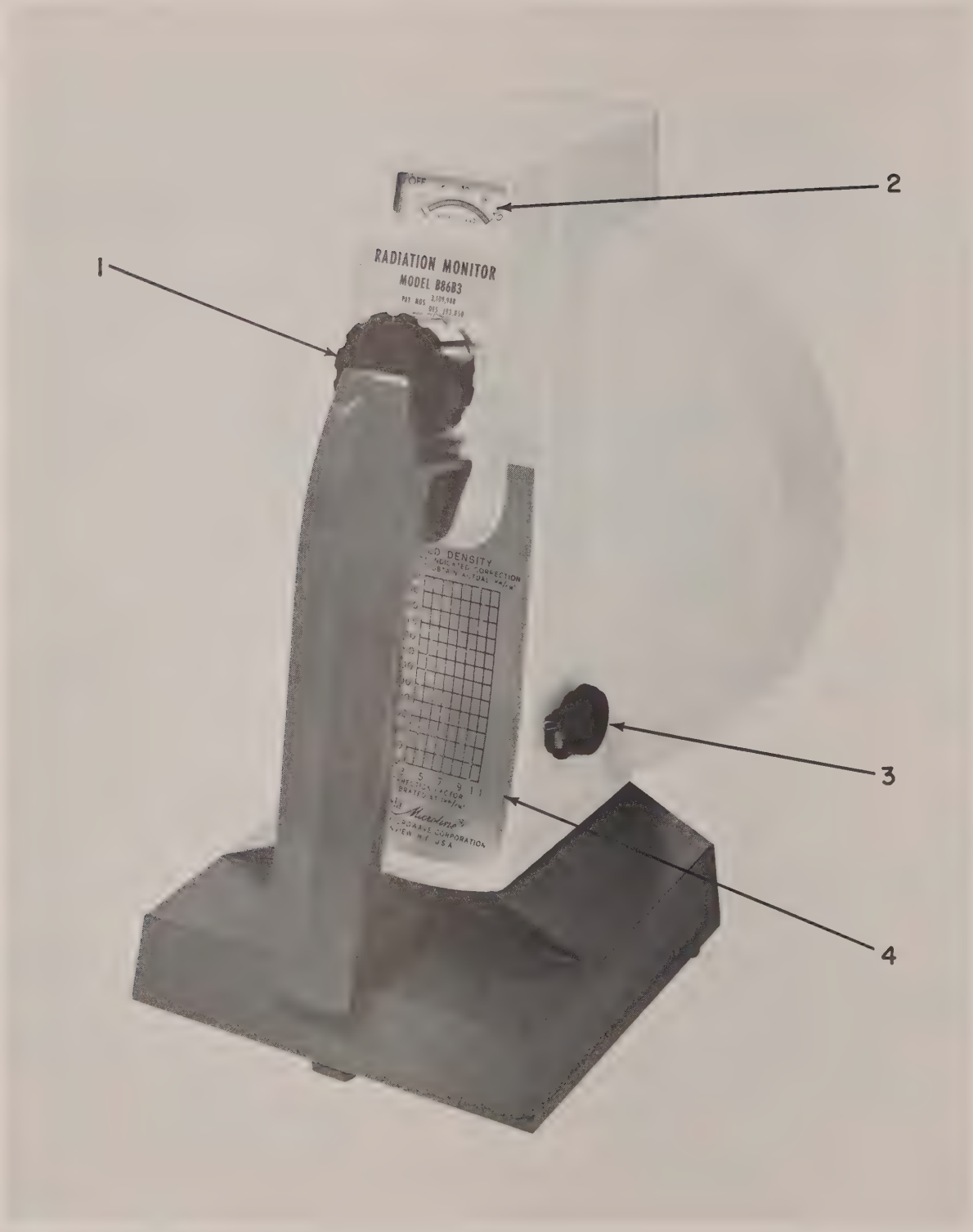


Figure 2-2. Monitor Operating Controls, Indicators and Connectors

Table 2-1. Functions of Operating Controls, Indicators and Connectors

| Fig. 2-2 Index No. | Control, Indicator or Connector | Function |
|---|---|---|
| 1. | On-Off switch and Zero control | Provides means of energizing Monitor and zeroing antenna thermistor bridge circuit as indicated on meter. |
| 2. | Meter | Indicates level of r-f field in $mw/cm^2$ as sensed by antenna. Safe level indicated by green area; red area (10 $mw/cm^2$) indicates unsafe area. OFF position on scale indicates instrument deenergized. |
| 3. | Recorder Output jack | Phone jack to permit external display of field density on remote meter. When used, instrument meter is bypassed. |
| 4. | Calibration Chart | Provides correction factor vs. frequency; meter reading is multiplied by correction factor to obtain accurate measurement. |

2-14. REMOTE OPERATION. (See figure 2-3.) For remote operation of the Monitor, proceed as follows:

NOTE

Remote meter must have 1.0 ma, 50 millivolt full-scale movement.

a. Prior to making remote measurements, calibrate the remote meter against the monitor meter, including the zero adjustment, by applying a known indication to first the monitor meter and then the remote meter and noting the difference in the meter indications. This procedure should be repeated using various known indications.

b. Set the Monitor at the desired point in the path of the r-f field with the r-f source deenergized.

c. Connect remote meter via sufficient cable length to Recorder Output jack on Monitor.

d. Energize Monitor, as before, and zero meter.

e. Energize r-f source and read field density on remote meter.

f. At r-f source operating frequency, determine correction factor from Monitor chart and multiply remote indication by this value to obtain accurate field density in $mw/cm^2$.

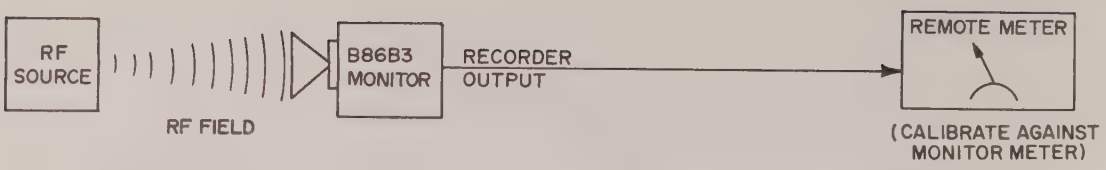


Figure 2-3. Remote Measurement Setup

2-15. BATTERY CHARGING PROCEDURE. The Monitor battery pack must be recharged when there is excessive meter drift and/or the meter cannot be zeroed. Recharge the nickel-cadmium battery pack as follows:

a. Remove four screws securing cover to pedestal bottom.

CAUTION

Never disconnect batteries during charging cycle or damage to the unit will result.

b. Remove plug end of line cord from bottom of instrument and connect to a standard 110-volt, 50 to 60 $H_Z$ line voltage source.

NOTE

If batteries are being recharged from a 110-volt, 50 $H_Z$ source, the charge time will be approximately 20% longer.

c. Charge batteries for approximately 16 hours.

NOTE

If it is desired to recharge the battery from a 220-volt, 50 to 60 $H_Z$ source, charge capacitor C1 must be changed from a 1.0 uf to a 0.5 uf value. (Refer to Section IV.) If line frequency is 50 $H_Z$, a 20% longer charge time is required, as before.

2-16. RESHIPMENT

2-17. If possible, in the event the Monitor was damaged during shipment, or if the instrument requires repair, use the original packing container and materials. If a substitute shipping container is used, make certain it has strong cardboard or wooden sides and heavy wrappings. The Monitor should be surrounded by ample padding when placed in the container. After packing, the container should be clearly marked "FRAGILE" and "DELICATE INSTRUMENT" on the surfaces. Refer to Section V for more detailed shipping instructions.

# SECTION III

# THEORY OF OPERATION

## 3-1. GENERAL.

3-2. Due to the small number of components and relative simplicity of operation, the following discussion is based on the schematic diagram, figure 3-1.

## 3-3. BRIDGE CIRCUIT OPERATION. (See figure 3-1.)

3-4. The heart of the Monitor consists of a bridge circuit, with the series combination of four antenna thermistor elements as one arm of the bridge. The other bridge arms consist of resistors R3, R4, and R5, with the combination of Meter Calibration adjust potentiometer R2. Recorder output jack J1 and meter M1 connected across the bridge.

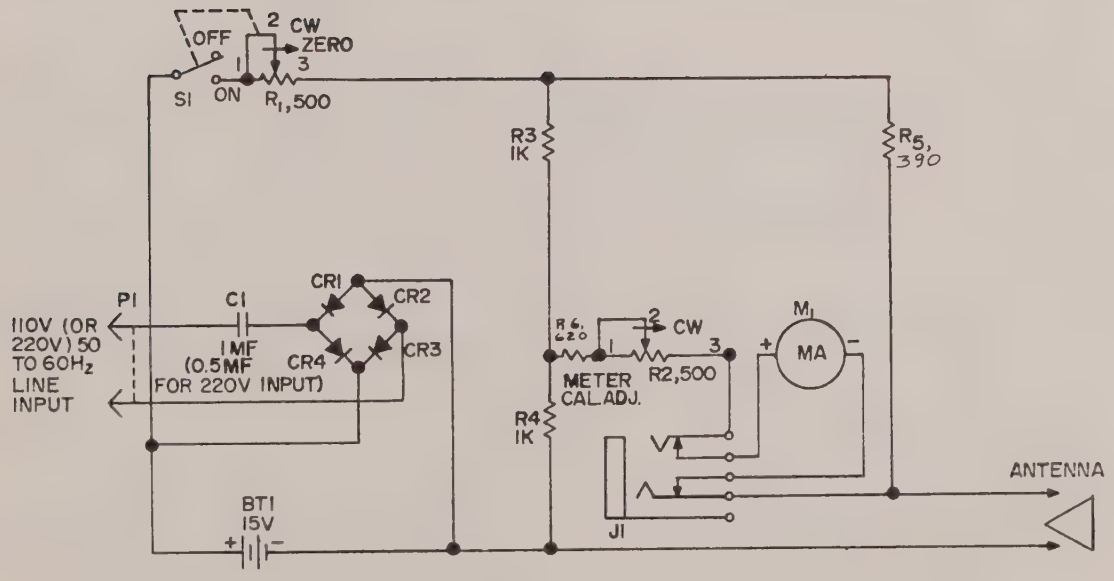


Figure 3-1. Radiation Monitor, Schematic Diagram

3-5. In the absence of external monitoring, meter M1 is in the circuit. When the combination On-Off switch S1 and Zero control R1 is activated, current from battery BT1 flows into the bridge causing meter M1 to indicate degree of bridge unbalance. Zero control R1 effectively controls the amount of current through each half of the bridge such that when meter M1 indicates zero or a pre-set bridge unbalance, thermistor resistance is approximately 300 ohms.

3-6. When r-f energy illuminates the antenna assembly, the resistance of one or more of the thermistors decreases, depending on polarization and intensity of the intercepted field. The net change in total resistance of that arm of the bridge, is then proportional to the intensity of all r-f radiation impinging on the antenna surface. Due to the net change in bridge resistance, an unbalance results which causes a proportional change in bridge current. Thus, the current change causes meter M1 to deflect by an amount corresponding to the intensity of the r-f field. The internal Meter Cal Adjust potentiometer R2 provides a means of calibrating the scale of meter M1 to determine proper correction factor vs frequency over the operating bandwidth.

## 3-7. BATTERY CHARGING CIRCUIT.

3-8. The battery charging circuit consists of bridge rectifier diodes CR1 through CR4, capacitor C1, and battery BT1. With line cord plug P1 connected to a 110 or 220-volt, 50 to 60 $H_Z$ source, the ac line voltage input is rectified and applied, in the proper polarity, to battery BT1, thereby charging the battery.

NOTE

When charging the battery from a 220-volt source, capacitor C1 must be changed to 0.5 uf. When the battery is being charged from a 50 $H_Z$ source, approximately 20% longer charging time is required.

# SECTION IV

# MAINTENANCE

## 4-1. GENERAL.

4-2. This section provides servicing information and instructions for performing calibration and repair of the Monitor.

**CAUTION**

**Once the antenna assembly is disturbed or disassembled, the calibration data furnished on the FIELD DENSITY correction factor chart is no longer valid, and the instrument must be recalibrated.**

## 4-3. PREPARATION FOR MAINTENANCE.

4-4. To effectively calibrate or check the operation of the Monitor, the instrument should be placed in an anechoic chamber and connected to a remote readout device such as a null meter. Refer to paragraphs 4-10 through 4-16 for applicable procedures.

## 4-5. TEST EQUIPMENT REQUIRED.

4-6. Test equipment required to check and/or calibrate the Monitor is listed in table 4-1. Alternate equipment with equal or greater specifications may be substituted.

Table 4-1. Test Equipment Required for Maintenance

| Test Equipment | Manufacturer | Use |
|---|---|---|
| Anechoic Chamber | Dimensions of at least 6' x 6' x 6' | Test and calibration of Monitor. |
| Oscillator | A.I.L., type 125 | RF source for low frequency tests. |
| Low Pass Filter | H-P 360D | Calibration from 500 $MH_Z$ to 4100 $MH_Z$. |
| Thermocouple Power Meter | Narda Model 443 (2) | Monitoring of incident and reflected power. |
| Thermocouple Mount | Narda Model 471A (2) | Monitoring of incident and reflected power. |
| Attenuator Pad | Narda Model 757C-20 (2) | Monitoring of incident and reflected power. |

Table 4-1. Test Equipment Required for Maintenance (Continued)

| Test Equipment | Manufacturer | Use |
|---|---|---|
| Attenuator Pad | Narda Model 757C-10 (1) | Monitoring of incident and reflected power. |
| Dual Directional Coupler | Narda Model 3020A | Monitoring of incident and reflected power, 500 $MH_Z$ to 1.0 $GH_Z$. |
| Dual Directional Coupler | Narda Model 3022 | Monitoring of incident and reflected power, 1.0 to 4.0 $GH_Z$. |
| Dual Directional Coupler | Narda Model 3024 | Monitoring of incident and reflected power, 5.4 to 8.0 $GH_Z$. |
| W.G. Directional Coupler | Narda Model 1080 | Monitoring of incident and reflected power, 8.2 to 12.4 $GH_Z$. |
| W.G. Thermocouple Mount | Narda Model 1400A | Monitoring of incident power. |
| Isolator, Coaxial | Sperry Model D44L15 | RF line isolator, 1.0 to 2.0 $GH_Z$. |
| W.G. to Coaxial Adapter | Narda Model 615 | Transition from waveguide to coax, 2.0 to 2.6 $GH_Z$ |
| W.G. to Coaxial Adapter | Narda Model 614A | Transition from waveguide to coax, 2.6 to 4.0 $GH_Z$ |
| W.G. to Coaxial Adapter | Narda Model 612A | Transition from waveguide to coax, 5.4 to 8.0 $GH_Z$ |
| W.G. to Coaxial Adapter | Narda Model 601A | Transition from waveguide to coax, 8.2 to 12.4 $GH_Z$ |
| Isolator, Coaxial | Sperry Model D44S15 | RF line isolation, 2.0 to 4.0 $GH_Z$. |
| Isolator, Coaxial | Addington Lab Model 217-6000 | RF line isolation, 4.0 to 8.0 $GH_Z$. |
| Isolator, W.G. | Narda Model 1210 | RF line isolation, 8.2 to 12.4 $GH_Z$. |
| UHF Antenna | Jerrold PUX-900 | Radiate r-f energy, 500 $MH_Z$ to 1.0 $GH_Z$. |

Table 4-1. Test Equipment Required for Maintenance (Continued)

| Test Equipment | Manufacturer | Use |
|---|---|---|
| Null Meter | H-P 419A | Remote readout of radiated power. |
| Log Periodic Antenna | A. E. L. Model 101B | Radiate r-f energy, 1.0 to 2.0 $GH_Z$. |
| Standard Gain Horn | Narda Model 645 | Radiate r-f energy, 2.0 to 2.6 $GH_Z$. |
| Standard Gain Horn | Narda Model 644 | Radiate r-f energy, 2.6 to 4.0 $GH_Z$. |
| Signal Source | Narda Model 9500 | Generate r-f energy, 2.0 to 12.4 $GH_Z$. |
| TWT Amplifier | Servo Model S979 | Amplifies signal to proper level, 2.0 to 4.0 $GH_Z$ |
| TWT Amplifier | Servo Model C979 | Amplifies signal to proper level, 5.4 to 8.0 $GH_Z$ |
| TWT Amplifier | Servo Model H979 | Amplifies signal to proper level, 8.2 to 12.4 $GH_Z$ |
| Standard Gain Horn | Narda Model 642 | Radiate r-f energy, 5.4 to 8.0 $GH_Z$. |
| Standard Gain Horn | Narda Model 640 | Radiate r-f energy, 8.2 to 12.4 $GH_Z$. |
| Radiation Monitor | Narda Model B86B3 | Calibrated to NBS standards for comparison test. |
| Multimeter | Simpson 260 | Charge current measurement. |
| Precision Decade Resistance | | |

## 4-7. CALIBRATION AND PERFORMANCE TEST PROCEDURES.

4-8. A Total of five test setups are required to accurately calibrate and rate the performance. Each of these setups span a portion of the Monitor operating bandwidth of 0.45 to 12.4 $GH_Z$. In implementing each test setup, the Monitor is accurately calibrated at the following 13 discrete frequencies:

| | | |
|---|---|---|
| 500 $MH_z$ | 1500 $MH_z$ | 6000 $MH_z$ |
| 600 $MH_z$ | 2450 $MH_z$ | 8200 $MH_z$ |
| 800 $MH_z$ | 3000 $MH_z$ | 9000 $MH_z$ |
| 915 $MH_z$ | 4100 $MH_z$ | 11000 $MH_z$ |
| | | 12400 $MH_z$ |

4-9 GENERAL TEST REQUIREMENTS. The following test requirements are stipulated for the Monitor:

a. The instrument shall be tested with an incident power density of 2 $mw/cm^2$ indicated.

b. Qualitative tests shall be made to assure linearity of power density readings as a function of power density.

c. Instruments shall be tested in both the horizontal and vertical polarization positions.

d. Total spread of readings at all frequencies and both polarizations shall not exceed 10 db (10.0 to 1.0 power ratio).

e. The Test Data Record sheet must reflect specific frequency at which sensitivity calibration was made and all readings obtained for each instrument.

f. A calibration chart shall be provided for each instrument.

4-10. CALIBRATION PROCEDURES. Calibration and performance test procedures for the Monitor are divided into two groups: The first is a general procedure for determining the calibration factor for each test frequency above 2.0 $GH_z$; and the second is the calibration test procedure at frequencies from 500 $MH_z$ to 2.0 $GH_z$. Figure 4-1 illustrates an internal view of the Monitor.

4-11. Determining Calibration Factor. The calibration factor to be supplied at each of the test frequencies above 2.0 $GH_z$ is:

$$\text{CAL. F} = \text{K} = \frac{\text{Actual Pwr. Density}}{\text{Indicated Pwr. Density}} = \frac{\text{Pd}}{\text{Pdi}}$$

Determination of this calibration factor is based upon the expression:

$$P_T = \frac{P_D R^2 \lambda^2}{A_e}, \text{ where:}$$

$P_T$ = Power supplied to transmitting antenna in mw;

$P_D$ = Power density at Radiation Monitor in $mw/cm^2$;

R = Distance in cm between transmitting antenna and Monitor;

$A_e$ = Effective area of transmitting antenna;

and G = Gain of transmitting antenna.

If $A_e = \frac{G\lambda^2}{4\pi}$; then $P_T = \frac{P_D R^2 4\pi}{G}$

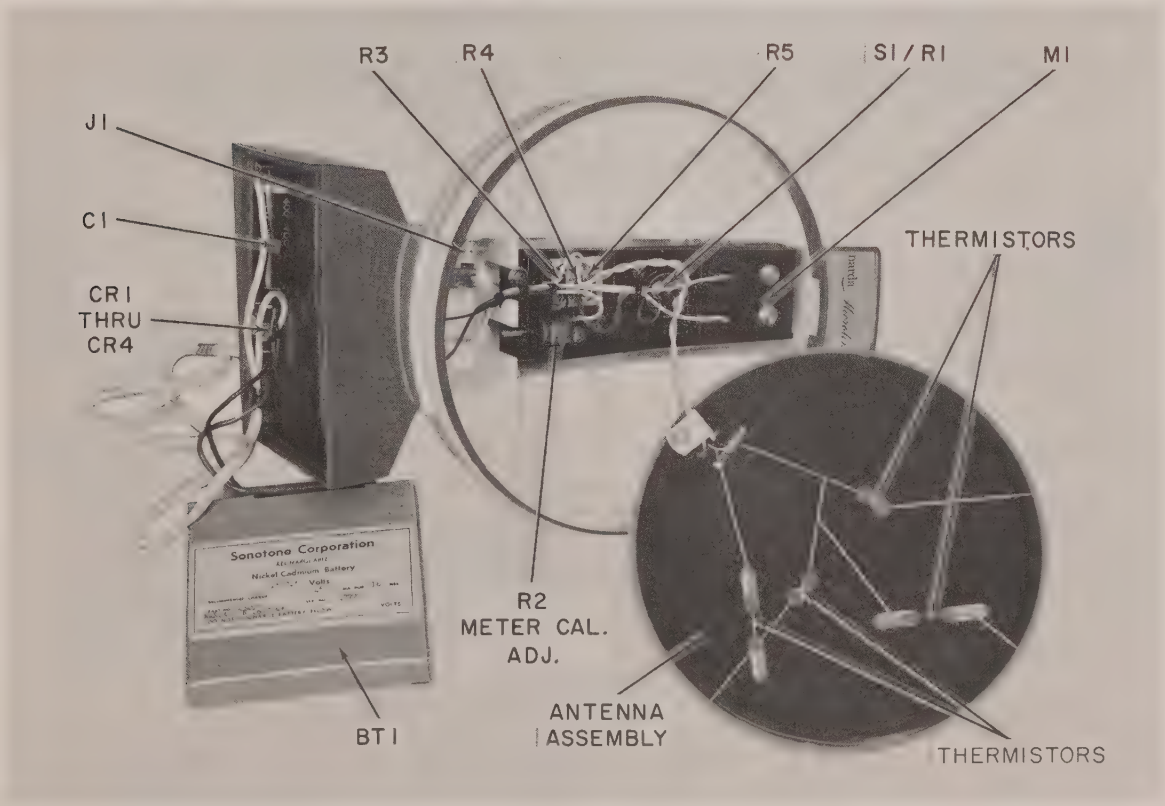


Figure 4-1. Radiation Monitor Internal View

4-12. The value $P_T$ must be calculated for a power density of 2 mw/cm$^2$ and a distance R of 47" or 119.38 cm for each of the transmitting antennas at the respective frequencies of calibration. All instruments are tested with transmitted power being swept ±50 $MH_z$ about the test frequency at a nominal 50 $H_z$ rate.

4-13. Calibration Test Procedure at Frequencies above 2.0 $GH_z$. (See figures 4-2 through 4-4.) Perform the calibration procedure at frequencies above 2.0 $GH_z$ as follows:

a. Remove four (4) screws securing bottom pedestal plate to instrument.

b. Remove battery (do not disconnect) to gain access to adjustment holes through pedestal bottom and set Meter Calibration Adjust potentiometer R2 fully counterclockwise. (See figure 4-1.)

c. Using test setup shown in figure 4-4 position Monitor in Anechoic chamber at distance of 47" from transmitting horn. Make certain that center-line of transmitting horn and center-line of Monitor antenna are at equal heights.

d. Connect external remote-reading null meter to Monitor Recorder Output jack J1 in series with the precision decade resistance box.

e. Set Monitor On-Off-Zero control knob to On position and set r-f signal source to 6.0 $GH_z$. Set proper sweep bandwidth of ±50 $MH_z$ at 50 $H_z$ rate.

f. Transmit theoretical power $P_T$ for 2 mw/cm$^2$ at a distance of 47". (Refer to table 4-2.)

g. Adjust decade resistance value to obtain a null meter reading of 5.1 mv (2 mw/cm$^2$.) Record decade resistance value.

h. Remove Monitor from Anechoic Chamber; adjust Zero control R1 for a meter indication of 20 mw/cm$^2$.

i. Set decade resistance value to zero (0) ohms. Adjust Meter Calibration Adjust potentiometer R2 to restore 20 mw/cm$^2$ indication on external null meter.

j. Using appropriate test setup shown on figures 4-2 through 4-4, measure incident and reflected power to transmitting horn for each test frequency between 2.0 and 12.4 $GH_z$, as listed in paragraph 4-8, to obtain a power density meter indication of 5.1 mv (2 mw/cm$^2$). (Refer to table 4-2 for theoretical powers)

k. Calculate actual power transmitted by the formula.

$P_{T_a} = P_{T_1} - P_{T_R}$, where;

$P_{T_1}$ = incident power at transmitting horn, and

$P_{T_R}$ = reflected power at transmitting horn

Table 4-2.

Theoretical Power $P_T$ for 2 mw/cm$^2$
at a Distance of 47 inches

| Frequency ($GH_z$) | Theoretical Power |
|---|---|
| 1.5 | 11.0 |
| 2.45 | 11.6 |
| 3.0 | 9.0 |
| 4.0 | 5.1 |
| 6.0 | 9.86 |
| 8.2 | 11.86 |
| 9.0 | 10.08 |
| 11.0 | 7.06 |
| 12.4 | 5.66 |

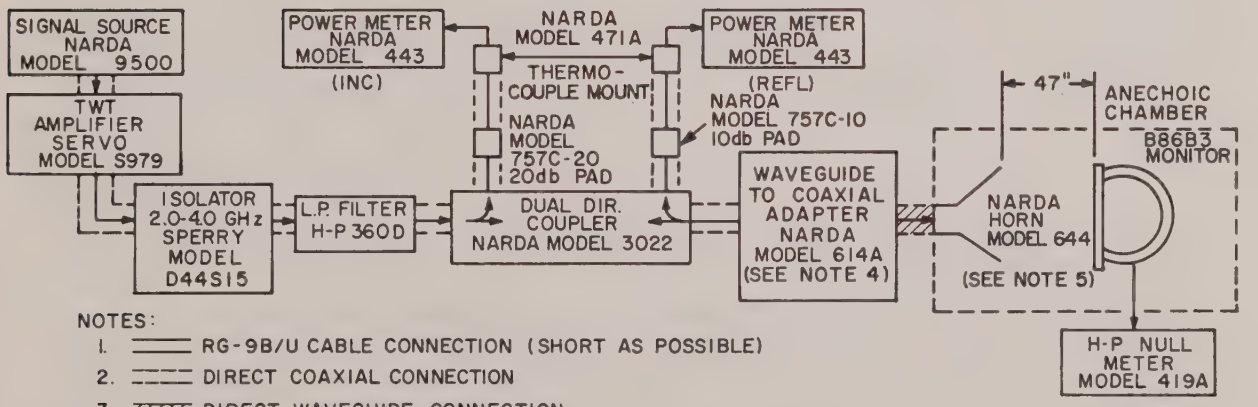
SIGNAL SOURCE NARDA MODEL 9500
TWT AMPLIFIER SERVO MODEL S979
ISOLATOR 2.0-4.0 GHz SPERRY MODEL D44S15
L.P. FILTER H-P 360D
POWER METER NARDA MODEL 443
(INC)
NARDA MODEL 471A
THERMO-COUPLE MOUNT
NARDA MODEL 757C-20 20db PAD
DUAL DIR. COUPLER NARDA MODEL 3022
POWER METER NARDA MODEL 443
(REFL)
NARDA MODEL 757C-10 10db PAD
WAVEGUIDE TO COAXIAL ADAPTER NARDA MODEL 614A (SEE NOTE 4)
47"
ANECHOIC CHAMBER
B86B3 MONITOR
NARDA HORN MODEL 644
(SEE NOTE 5)
H-P NULL METER MODEL 419A
NOTES:
1. RG-9B/U CABLE CONNECTION (SHORT AS POSSIBLE)
2. DIRECT COAXIAL CONNECTION
3. DIRECT WAVEGUIDE CONNECTION
4. WHEN MAKING CALIBRATIONS FROM 2.0 TO 2.6 GHz USE MODEL 615
5. WHEN MAKING CALIBRATIONS FROM 2.0 TO 2.6 GHz USE MODEL 645

Figure 4-2. Calibration Test Setup for 2.0 to 4.0 $GH_z$ Frequency Range

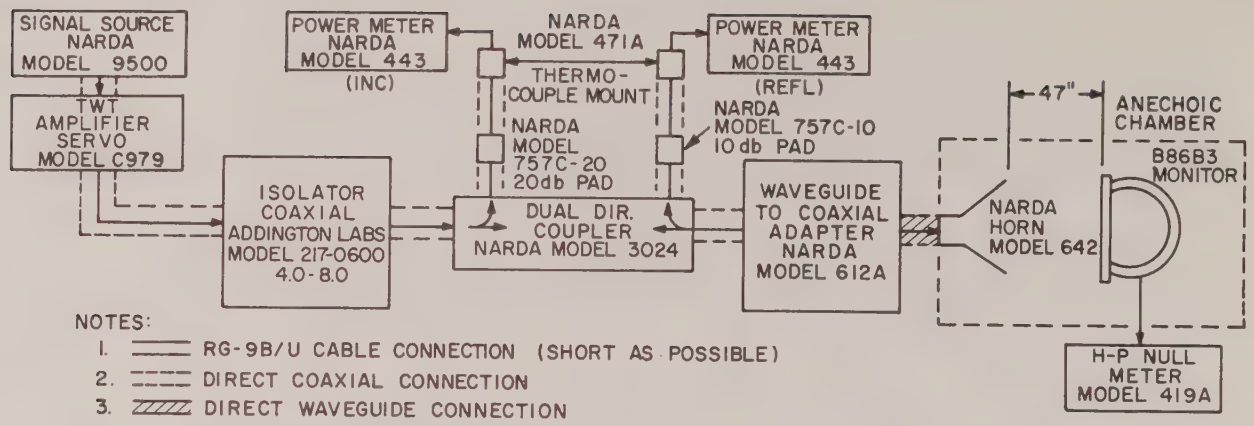
SIGNAL SOURCE NARDA MODEL 9500
TWT AMPLIFIER SERVO MODEL C979
POWER METER NARDA MODEL 443 (INC)
NARDA MODEL 471A THERMO-COUPLE MOUNT
NARDA MODEL 757C-20 20db PAD
POWER METER NARDA MODEL 443 (REFL)
NARDA MODEL 757C-10 10 db PAD
ISOLATOR COAXIAL ADDINGTON LABS MODEL 217-0600 4.0-8.0
DUAL DIR. COUPLER NARDA MODEL 3024
WAVEGUIDE TO COAXIAL ADAPTER NARDA MODEL 612A
47"
ANECHOIC CHAMBER
B86B3 MONITOR
NARDA HORN MODEL 642
H-P NULL METER MODEL 419A
NOTES:
1. RG-9B/U CABLE CONNECTION (SHORT AS POSSIBLE)
2. DIRECT COAXIAL CONNECTION
3. DIRECT WAVEGUIDE CONNECTION

Figure 4-3. Calibration Test Setup for 5.4 to 8.0 $GH_z$ Frequency Range

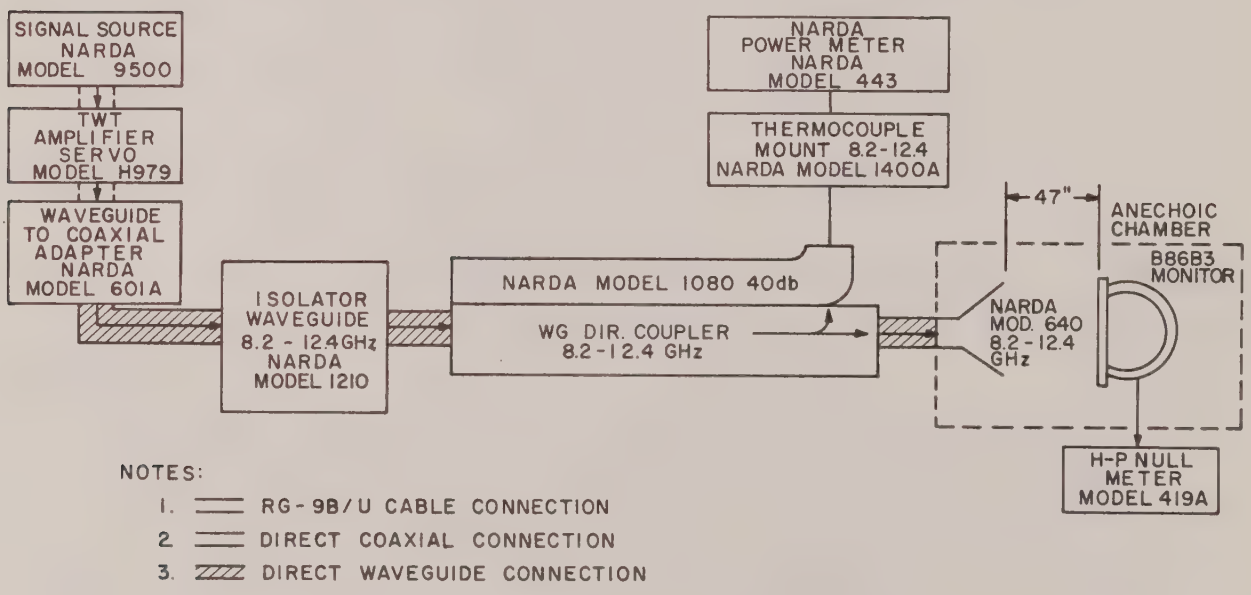
SIGNAL SOURCE NARDA MODEL 9500
TWT AMPLIFIER SERVO MODEL H979
WAVEGUIDE TO COAXIAL ADAPTER NARDA MODEL 601A
ISOLATOR WAVEGUIDE 8.2 - 12.4GHz NARDA MODEL 1210
NARDA POWER METER NARDA MODEL 443
THERMOCOUPLE MOUNT 8.2-12.4 NARDA MODEL 1400A
NARDA MODEL 1080 40db
WG DIR. COUPLER 8.2-12.4 GHz
47"
ANECHOIC CHAMBER
B86B3 MONITOR
NARDA MOD. 640 8.2-12.4 GHz
H-P NULL METER MODEL 419A
NOTES:
1. RG-9B/U CABLE CONNECTION
2. DIRECT COAXIAL CONNECTION
3. DIRECT WAVEGUIDE CONNECTION

Figure 4-4. Calibration Test Setup for 8.2 to 12.4 $GH_z$ Frequency Range

1. Calculate calibration factor at each frequency equal to

$$\frac{2}{Pdi} = \text{Calibration Factor}$$

NOTE

Refer to Meter Reading Conversion Chart, table 4-3, to obtain indicated power density.

Table 4-3.

Meter Reading Conversion Chart

| Null Meter mv | Pdi $mw/cm^2$ (Monitor Meter) | Null Meter mv | Pdi $mw/cm^2$ (Monitor Meter) | Null Meter mv | Pdi $mw/cm^2$ (Monitor Meter) |
|---|---|---|---|---|---|
| 0.4 | 0.12 | 2.0 | 0.76 | 4.1 | 1.60 |
| 0.45 | 0.15 | 2.1 | 0.80 | 4.2 | 1.64 |
| 0.50 | 0.17 | 2.2 | 0.84 | 4.3 | 1.69 |
| 0.55 | 0.18 | 2.3 | 0.89 | 4.4 | 1.73 |
| 0.60 | 0.21 | 2.4 | 0.93 | 4.5 | 1.77 |
| 0.65 | 0.23 | 2.5 | 1.97 | 4.6 | 1.80 |
| 0.70 | 0.25 | 2.6 | 1.00 | 4.7 | 1.85 |
| 0.75 | 0.27 | 2.7 | 1.05 | 4.8 | 1.89 |
| 0.80 | 0.29 | 2.8 | 1.09 | 4.9 | 1.93 |
| 0.85 | 0.31 | 2.9 | 1.13 | 5.0 | 1.97 |
| 0.90 | 0.33 | 3.0 | 1.16 | 5.1 | 2.00 |
| 1.0 | 0.35 | 3.1 | 1.20 | 5.2 | 2.05 |
| 1.1 | 0.40 | 3.2 | 1.24 | 5.3 | 2.09 |
| 1.2 | 0.44 | 3.3 | 1.28 | 5.4 | 2.14 |
| 1.3 | 0.48 | 3.4 | 1.32 | 5.5 | 2.18 |
| 1.4 | 0.52 | 3.5 | 1.36 | 5.6 | 2.20 |
| 1.5 | 0.56 | 3.6 | 1.40 | 5.7 | 2.25 |
| 1.6 | 0.60 | 3.7 | 1.44 | 5.8 | 2.30 |
| 1.7 | 0.64 | 3.8 | 1.48 | 5.9 | 2.34 |
| 1.8 | 0.68 | 3.9 | 1.52 | 6.0 | 2.37 |
| 1.9 | 0.72 | 4.0 | 1.56 | | |

4-14. Calibration Test Procedure at Frequencies Below 2.0 $GH_z$. (See figures 4-5 and 4-6.) Perform the calibration procedure at frequencies below 2.0 $GH_z$ as follows:

NOTE

Three Model B86B3 Radiation Monitors must be calibrated either at the factory or by the NBS. These calibrated monitors must be used as standard and calibrations performed on a comparison basis.

a. Position one of the standard monitors in the chamber and adjust the power output from the transmitting antenna to an arbitrary value which yields a meter reading of 2 $mw/cm^2$.

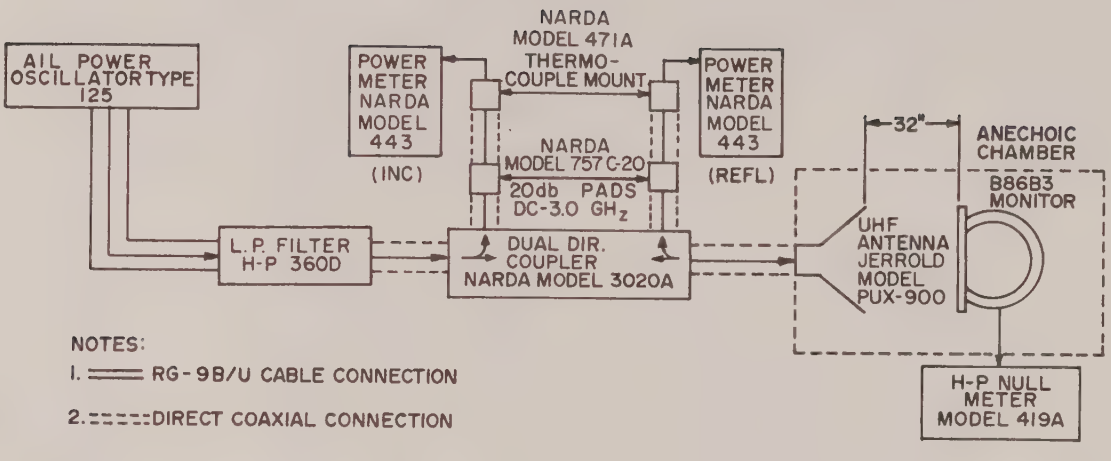


Figure 4-5. Calibration Test Setup for 500 $MH_z$ to 1.0 $GH_z$ Frequency Range

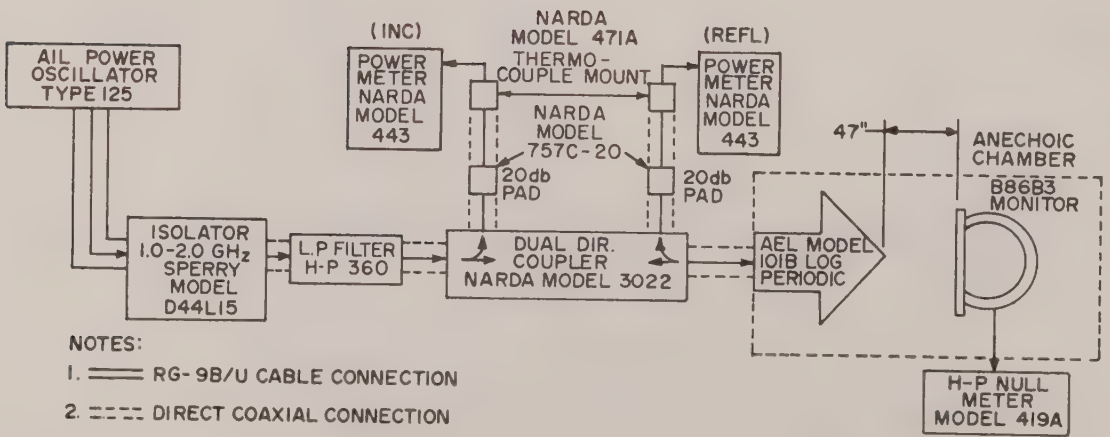


Figure 4-6. Calibration Test Setup for 1.0 to 2.0 $GH_z$ Frequency Range

b. Replace the second standard monitor with one of the other standards. Record the meter reading indicated.

c. Replace the second standard monitor with the third standard and record the meter reading indicated.

d. Readjust the transmitting antenna power output to the average of the readings recorded in steps a. through c.

e. Place the monitor under test in the chamber and record the meter reading.

f. Calculate the actual power transmitted using the formula specified in paragraph 4-13 step l.

g. Calculate the calibration factor using the formula specified in paragraph 4-13 step m.

h. Repeat steps a. through g. for each calibration frequency under 2.0 $GH_Z$.

4-15. Battery Charge Current Check. Perform a battery charge current check as follows:

a. Set combination On-Off-Zero control to Off position.

b. Remove four (4) screws securing bottom pedestal plate to instrument and remove plate.

c. Disconnect one terminal of battery connector from battery and connect the Simpson 260 in series with the other battery terminal and battery connector terminal.

d. Set up Simpson 260 for dc current indication, and plug instrument line cord plug into 110-volt, 60 $H_Z$ line voltage outlet. The dc meter should indicate a nominal 35 ma charging current.

## 4-16. TROUBLESHOOTING PROCEDURES.

4-17. A definite indication of trouble in the Monitor is apparent when the meter cannot be properly zeroed and/or the reading drifts. Usually, if the meter cannot be zeroed it indicates that the battery requires recharging. If, after the battery is charged, the meter still cannot be zeroed, or if the reading drifts, it is possible that one or more of the antenna thermistor elements have opened up.

CAUTION

If the batteries are fully charged and the trouble is localized to the antenna assembly, do not disassemble the antenna unless the user is prepared to recalibrate the instrument after replacing the antenna thermistor assembly. This assembly is not repairable in the field and should be returned to the factory. In addition, it is advisable to return the entire instrument to the factory for repair and recalibration, due to the complexity of the calibration test procedure.

4-18. Troubles localized to the battery charging circuit in the pedestal base are readily repaired after removing the base plate to expose the bridge rectifier diodes, capacitor and battery. (See figure 4-1.)

# SECTION V

# PARTS LIST

## 5-1. GENERAL.

5-2. This section provides a listing of the replaceable parts of the Monitor. The listing contains the necessary information for the ordering of replacement parts. Parts are listed in alpha-numerical order of their reference designators in accordance with the designators assigned to these parts in the schematic diagrams included in this manual. Parts nomenclature, with descriptive data for ordering purposes, are provided along with the Narda part number of each part. The replaceable parts list is presented in table 5-1.

Table 5-1. Replaceable Parts List

| Reference Designation | Description | Narda Part No. | Qty. |
|---|---|---|---|
| BT1 | BATTERY: Nickel-Cadmium, 15V | 88008000 | 1 |
| C1 | CAPACITOR: 1.0 ufd, ±20%, 400V | 80165000 | 1 |
| CR1 | DIODE: 1N645 | 84512005 | 4 |
| CR2 | Same as CR1 | | |
| CR3 | Same as CR1 | | |
| CR4 | Same as CR1 | | |
| J1 | JACK: Phone | 81555000 | 1 |
| M1 | METER: 0-1 Ma, ±3%, 50 mw | 82513000 | 1 |
| R1 | RESISTOR: Variable, 500Ω, ±10%, 1W | 83081002 | 1 |
| R2 | RESISTOR: Variable, 500Ω, ±20%, 1/3W | 83007035 | 1 |
| R3 | RESISTOR: Fixed, composition, 1K, ±5%,1/2W | 83010049 | 2 |
| R4 | Same as R3 | | |
| R5 | RESISTOR: Fixed, composition, 390Ω, ±5%1/2W | 83010039 | 1 |
| R6 | RESISTOR: Fixed, composition, 620Ω, ±5%1/2W | 83010044 | 1 |
| S1 | SWITCH: (Part of R1) | 2616718 | 1 |
| - | ANTENNA ASSY | 120796 | 1 |
| - | ANTENNA COVER | 220522 | 1 |
| - | RING, RETAINING | 330533 | 1 |

## 5-3. ORDERING INFORMATION.

5-4. If it is desired to order replacement parts from the instrument manufacturer, address the order to:

SALES DEPARTMENT
The Narda Microwave Corporation
Plainview, L.I., New York

5-5. When ordering a part in this manner, the following information should be provided.

a. Model and serial number of the instrument

b. Narda part number

c. Reference designation

d. Description.

5-6. When ordering a part not listed in table 5-1, a complete description of the part, including its function and location, should be provided with the model and serial number of the instrument.

## 5-7. CUSTOMER REPAIR SERVICE.

5-8. Repairs or recalibration of Narda Microline products are performed by the Customer Service Department at the factory; however, before returning any instrument, contact the Narda Microwave Corporation or the Narda Sales Representative in the area for shipping instructions. When requesting maintenance, complete the form provided at the rear of this manual.